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CONTENTS.

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QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

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N. D. C. HODGES, 874 BROADWAY, N. Y.

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TO VOLUME XVIII OF

SCIENCE

is in preparation, and will be issued at an early date.

SCIENCE

NEW YORK, FEBRUARY 17, 1898.

A REMARKABLE OCCURRENCE OF SELENITE.

BY DR. J. E. TALMAGE, SALT LAKE CITY, UTAH.

THE writer is pleased to report a deposit of selenite in southern Utah, which is remarkable for the size, perfection, and variety of the crystals there to be found. It is situated in the newly-created

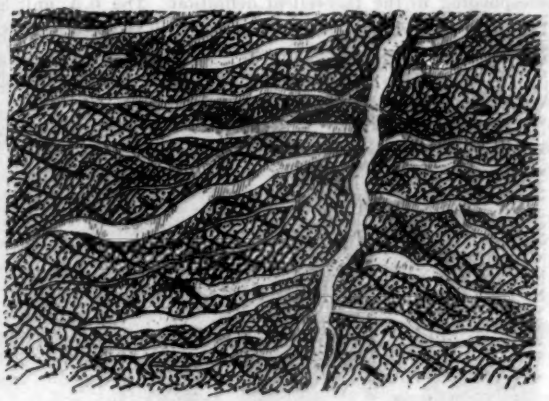

FIG. 1.

county of Wayne, in what is locally known as the South Wash, which is connected with the canyon of the Fremont River, and this in turn is tributary to the Colorado.

The formation in the neighborhood of the deposit in question is mostly sandstone and argillite, with a top dressing of erratic boulders of lava. Innumerable fantastic forms in stone declare the cutting power of water and wind; indeed, the entire region has been the site of wonderful eroding action. Ripple marks in great distinctness are frequent in the sandstone of this region and other evidences of lake formation are common.

The most convenient way to reach the deposit from the north is by way of either the Grand Wash or the Capitol Wash, spurs of the Fremont Canyon, both of which abound in scenes which are terribly grand. As one leaves the deep canyons, however, and enters the side washes, the scenery assumes a milder, though a scarcely less diversified, character.

Here and there along the gorges are outcroppings of gypsum, varying in degrees of purity; and seams of this material cut through the country rock in all directions. In places, veins of satin spar, as thin as a sheet of note-paper, or even an inch in thickness, can be traced for many hundreds of yards upon the surface of the ground in uninterrupted course, except for intersecting planes of the same material. On the walls of the ravines and canyons places are seen where spar veins cross and recross each other with bewildering profusion. Here (Fig. 1) is a sketch of such seams in an exposed face eight by twelve feet on the steep side of a ravine.

Gypsum in all varieties may be found within a short radius, fibrous and scaly laminæ, plaster-stone or rock-gypsum in masses, lumps of pure alabaster, and fragments of selenite crystals are scattered along the washes and strewn upon the bench-lands, as they have been left by the fierce floods which tore them loose from the place of formation. These occurrences form an encouraging introduction to the superb deposit of crystals already mentioned.

The crystals occur in a cave, and this is inclosed by a thick shell forming a mound which stands in relief on the side of a hill bounding the Wash. Of this formation, a good idea may be gained from Fig. 2, which is reproduced from a photograph. The mound is somewhat of an egg-shape, 35 feet in length east and west, 10 feet in breadth, and of an average height of 20 feet from the ground on the lower side; all outside measurements. This selenite mass seems to have been left exposed by the weathering of the loosened friable sand and clay, of which the hill whereon the mound is situated is composed. The mound consists entirely of selenite, the outside having a somewhat battered and roughened appearance from the action of the wind-driven sand; yet the whole exterior is made up of the exposed ends and sides of crystals, and in the sunlight the formation glistens with indescribable beauty. The outer walls are generally regular, though there are a few depressions and sheltered niches, within which small prisms of selenite nestle snugly, in groups.

The entrance to the cavern faces the east, and when first observed by the writer it was about six feet in height, and three and a half in width. The cave can be traversed to a depth of 26 feet. Generally the crystals project from either side toward the central line of the cavern, approaching each other within about three feet, though some of the largest crystals extend entirely across the cavern like huge beams.

Fig. 3 is from a photograph of the interior of the cave, one massive crystal having been sawn off to afford a better view. The floor of the cavern consists mostly of sand, probably deposited by water in flood times, and carried in at all seasons by winds. Projecting out of the sandy floor are the terminations of many superb crystals. Inside the cavern, a yard from the entrance, the crystals descend within three feet of the bottom, so that one has to

FIG. 2.

stoop to pass; but farther in there is room to stand erect, and near the back wall a person may clamber up to a height of fifteen feet. Looking upward from the bottom of the cavern, one sees a mass of mammoth prisms, suggesting, but for their singular beauty, the heavy timbers of a deep mine. The entire deposit is a colossal group of crystals, the like of which is seldom to be seen.

The writer's attention was first attracted to the place through receiving several small specimens of the selenite from sheep-herders, who had discovered the deposit while searching for feeding-places, and who claimed to have found a mine of mica, which they called "isinglass." Their disgust was great when assured, by the conclusive experiment of holding a bit of the material in the flame of a candle, that the stuff was not what it seemed. I first visited the place in April last, and my rapture at the superb display of crystal beauty was checked by the evidences of vandalism on every hand. Some of the finest crystals had been hacked and carved, and cow-boys' initials were scratched and cut on almost every prismatic face which the light could reach. Visiting the place again six months later, I found that still greater destruction had been waged, and, becoming convinced that good crystals would soon be difficult to obtain, I took steps to secure legal claim to the land, and proceeded to remove the remaining crystals of greatest value to a place of safety. Under the auspices of the Deseret Museum of Salt Lake City, the work of removal is still in progress. Already over twenty tons of most beautiful crystals have been taken out and shipped to this city.

FIG. 3.

Prisms of perfect form and varying in length from one to five feet, and in weight from ten to one hundred pounds, are of frequent occurrence. One of the most regular yet taken out is four feet long, and the widest faces are six inches across. Cleaved slabs are obtainable six feet in length, and two and a half feet in breadth. One of the longest perfect prisms yet obtained extends fifty-one inches, and from one of its faces nineteen smaller crystals sprout. Twins are common, as are also compound terminations of very complicated structure. A magnificent group, weighing over six hundred pounds, was removed from the floor of the cavern; it was set up on the outside and photographed (see Fig. 4).

As to the habit of the crystals, in the midst of such variety it is difficult to specify. Prisms short and stout, also long and comparatively slender, are numerous; and of twins, the "swallow-tail" vie with the cruciform and penetration varieties in points of abundance and perfection. Some of the crystals are of perfect transparency, and cleaved slabs of this quality are common. Sometimes the prisms inclose sand and clay, which is so distributed as really to add to the beauty of the crystals in the eyes of all save the mineralogist. When fracture planes are made visible by striking a crystal containing such impurities, the particles appear on the internal planes as on shelves of glass.

Some of the finest specimens will probably be on exhibition in Chicago next summer.

THE FUTURE OHM, AMPERE, AND VOLT.

BY HENRY S. CARHART, ANN ARBOR MICH

SINCE the International Congress of Electricians in Paris in 1881, the most eminent physicists have been agreed as to the theoretical values to be assigned to the three fundamental units of electrical measurement; but it has been a matter of ten years' labor on the part of many distinguished investigators to embody these theoretical definitions in practical units for universal use.

Up to the date mentioned the two units of resistance in use were the British Association (B.A.) unit and the Siemens unit. Only the former represented an attempt to construct an ohm corresponding to the theoretical definition. The B.A. unit has served a useful purpose, but it is now known to be 1.34 per cent too small.

The "legal ohm" was provisionally adopted in 1883 by an international committee to which the Congress of 1881 had committed the subject. It was in the nature of a compromise, and fixed the practical ohm as the resistance at 0° C. of a column of mercury one square millimeter in cross-section and 106 centimeters long. Competent investigators, like Lord Rayleigh and Professor Mascart, contended that a column 106 3 centimeters in length was nearer the true value; but a few smaller values obtained by some well-known physicists decided the adoption of the mean value 106 centimeters. This conclusion satisfied no one, and the "legal ohm" was never legally or officially adopted by any European or American government.

FIG. 4.

Subsequently, Professor Rowland came forward with his determination of 106.32, and errors were found in the data of some who had contended for the lower values. Hence the number 106.3 has been tacitly accepted for two or three years already, and it is now believed that this does not differ from the true value by more that two units in the fifth figure; that is, the length of the mercurial column representing the true ohm is not less than 106.28 and not more than 106.32 centimeters.

Somewhat over two years ago a commission was appointed by the British Board of Trade to draft an "Order in Council" as a legal settlement of the units to be employed by the Board of Trade Electrical Bureau, and hence as the legal electrical units for Great

Britain. After this committee had made its report, but before the "Order in Council" had been signed by the Queen, an intimation was received from Professor von Helmholtz that something might be done toward international agreement if the order were delayed till he could communicate in person the results of the most recent determinations in Berlin. Accordingly von Helmholtz and some others were invited to be present at the British Association last August, and to sit with the famous B.A. "committee appointed for the purpose of constructing and issuing practical standards for use in electrical measurements." The report of the committee, recently published, says: "During the Edinburgh meeting the committee were honored with the presence of Dr. von Helmholtz, M. Guillaume of Paris, Professor Carhart of the United States Dr. Lindeck and Dr. Kahle of the Berlin Reichsanstalt. These gentlemen came by invitation to consider the question of establishing identical electrical standards in various countries." The committee had two long sessions, and there were present Professor Carey Foster, chairman, Lord Kelvin, Professors Ayrton, Perry, and Sylvanus Thompson, Dr. Oliver Lodge, Mr. Glazebrook, secretary, Mr. Preece of the Post-Office, Major Cardew of the Board of Trade Bureau, and others.

The most important results of these conferences were the abandonment of the time-honored B.A. unit, the disregard of the "legal" ohm, and the adoption of the mercury standard of 106.3 centimeters. The reports from Berlin and Paris showed most conclusively that mercurial standards, set up with the precautions recently adopted, agree with surprising accuracy. The uncertainty of the relation between the centimeter and the gramme was avoided by defining the mass of the mercury column of 106.3 centimeters in length, which has a resistance of one ohm. It is 14.4521 grammes. This corresponds to a specific gravity for mercury of 13.5956. "In reality the square-millimeter cross-section remains the elementary definition, but with the specification that this is arrived at by mercurial weighings."

Standards of resistance for industrial purposes in solid metal will still be made as heretofore. But it must be borne in mind that such resistances, especially when made of alloys, should be kept at a temperature near the one at which they have been standardized; otherwise small changes take place in the resistance, due perhaps to a kind of annealing and recrystallizing process.

It was further agreed with regard to the unit of current that the number 0.001118 should be adopted as the number of grammes of silver deposited per second from a neutral solution of nitrate of silver by a current of one ampere. This corresponds to 4.025 grammes per hour. The silver voltameter, with the proper manipulation, becomes, therefore, a secondary standard for the determination of the unit current.

The electromotive force of the Clark standard cell has been re-determined both in Berlin and Cambridge, England, within a year or two; and the results are in rather surprising agreement. A comparison of these determinations led the B.A committee to decide upon 1.434 as the number of volts representing the electromotive force of the old form of Clark cell at 15° C. containing a saturated solution of zinc sulphate and crystals in excess. This is .001 volt lower than the value heretofore assigned to this cell. It was not determined to adopt this form of cell as the standard, but only to decide upon its voltage when set up by competent persons in accordance with certain specific directions. My own form of Clark cell is perfectly portable, has an electromotive force of 1.44 volts at 15° C., and its change of electromotive force with temperature is only half as great as that of the old Clark cell containing crystals.

We have as yet in this country no bureau where concrete standards of resistance and standard instruments for other electrical units are preserved. Such a bureau, under federal control, is greatly to be desired. Germany has its Reichsanstalt, under the direction of von Helmholtz, in Berlin; England has not only the standards of the British Association in the keeping of Mr. Glazebrook at Cambridge, but also the Board of Trade Bureau in London, under the directorship of Major Cardew. Mr. Glazebrook undertakes the comparison and certification of standard coils for the English-speaking world, while the bureau in London issues certificates of instruments for commercial purposes in Great Britain.

Government bureaus mean certified standards and legally adopted units. The decisions of the B.A. committee last August were with the full concurrence of Professor von Helmholtz, and it is understood that the German government will adopt the B.A. proposals. The committee appointed by the Board of Trade in London has already made its supplementary report in accordance with the conclusions of the B.A. committee, and these units will doubtless very soon acquire a legal character in England. The coming electrical congress in Chicago will afford an opportunity for official delegates to adopt these same units for their respective countries, and official ratification will then naturally follow. Lord Kelvin (Sir Wm. Thomson) predicted at the close of the Edinburgh meeting that the system of units adopted by the B.A. committee will become thoroughly international. It should be the duty and pleasure of all electricians to contribute toward this result.

THE CLASSIFICATION AND NAMING OF IGNEOUS ROCKS.

BY W. S. BAILEY, WATERVILLE, ME.

THE discussions of Mr. Iddings[1] relating to the crystallization of lava have led him to conclusions that will undoubtedly prove of vast significance in the attempt to ground the study of rocks in a firm and sure foundation. Heretofore, most petrographers have busied themselves with descriptions of rock-types, confining their discussions principally to the mineralogical composition and the structure of the specimens studied, and to their similarity to other specimens assumed as types. Such work as this is of course absolutely necessary to the right treatment of rock classification. It is evident that we must first know the characteristics of bodies to be classified before we can hope to separate them into genetic groups. But the time has now come when students of rocks must seek for a generalization that will do for their science what the atomic theory has done for chemistry or the theory of evolution for the biological sciences, viz., elevate petrography from the position of a descriptive science to that of a philosophical one. Mr. Iddings's recent studies in the causes producing the differences noted in different lavas emanating from the same volcanic centre, and the generalizations drawn from them, will go far toward affording a philosophical basis for rock classification, and, consequently, toward the inception of a broader study of rocks in their relationships to each other than has heretofore been possible.

The rocks on the surface of the earth all tend toward the production of a few simple types, in which tendency may be traced the action of chemical laws, under the definite conditions existing at the surface, producing from unstable compounds those that are most stable under these conditions.

Mr. Iddings believes that the relation existing between chemical action and the conditions under which it occurs is discoverable not only in the breaking down (degradation) of rocks, but also in their construction. He believes that the intimate gradations in composition and structure that are known to exist between the types of eruptive rocks are due to the action of chemical laws under changing but definite conditions — conditions that are determined largely by the position of the magmas from which the rocks are derived. If this be true, petrographers have at last a thread to which they can tie the results of their investigations: they have offered them a conception as to the *cause* of the existence of eruptive rock-types, whose discussion *pro* and *con* will compel them to study not simply rock-specimens, but rather rock-masses, in the attempt to learn just what relations exist between their various parts, with respect to composition and structure, and to discover the conditions under which these parts were formed. In other words, *petrography*, as the result of this discussion, will become *petrology*, just as "natural history" has become "biology."

[1] J. P. Iddings, The Origin of Igneous Rocks, Bull. Philos. Soc., Washington, vol xii, 1892, p. 89.

It is not the theory of a science which urges the progress of that science, but it is the attempt to discover whether or not the suggested theory will explain the facts of the science, that leads to the latter's rapid development. The suggestion of the atomic theory demanded its discussion, and it was this discussion that advanced chemistry to the position it now occupies among the exact sciences. The theory of evolution did not by any means explain away the difficulty of accounting for the existence of many species of living things, but it was the attempt to discover whether the theory is founded on a secure basis or not, that has led to the wonderful progress of biology within the past quarter of a century. So the mere suggestion of Mr. Iddings's theory as to the origin of eruptive rocks, because of its comprehensiveness, is bound to lead to discussion that will in the end give us a conception of the cause of the almost infinite variety among these bodies more simple than any other conception that has thus far been held.

Mr. Iddings was highly favored in the beginning[1] of his studies by the opportunity afforded him of comparing the deep-seated portions of a series of rocks with their surface equivalents. Electric Peak and Sepulchre Mountain, in the Yellowstone National Park, are separated from each other by a great fault, in consequence of which the intrusive stock and its apophyses of Electric Peak are brought to the same horizon with the dykes and surface-flows of Sepulchre Mountain.

Upon comparing the Electric Peak intrusives with the Sepulchre Mountain effusives, it was found that, although each group comprehends a complex series of rock-types, the two groups have, on the whole, a striking similarity in composition. Certain characteristic minerals found in the intrusives are also common in the effusives. Moreover, the transition between the members of each series is so very gradual that it is impossible to draw any sharp line between the different types. These facts indicate the existence of a close relationship between the typical intrusives of Electric Peak and the typical effusives of Sepulchre Mountain, and a unity of origin for the members of each series, with a gradual change in the conditions under which the different members were formed. Though the individual members of the effusives differ markedly in structure from the members of the intrusive group, the two groups are regarded as having resulted from the cooling of what was originally one mass of magma, but which, in consequence of a differentiation of its parts, became separated into various magmas differing in composition. The differentiated magmas, upon their extrusion from the depths, consolidated as widely differing rocks, either of the intrusive type, or of the effusive type, according as the magmas cooled beneath the surface or upon it.

Examination of other regions of eruptive rocks reveals the same relationship existing between the various rock-types occurring in them. There is a more or less striking similarity in some respects between all types occurring within a region covered by rocks extruded from a single centre, and a marked difference between these and the series of rocks of other regions. Thus the rocks of a single eruptive centre are more closely related to each other than to similar mineralogical aggregates originating at a different centre, or, as Mr. Iddings expresses it, the rocks of a single centre are consanguinous.

No matter how different in mineralogical composition and in structure, all the products of a given centre — consanguinous products — should be grouped together in a classification of rocks, rather than rocks of similar mineralogical composition and similar structure from widely separated regions of volcanic activity. The differences in structure and mineralogical composition of consanguinous rocks are the result of the differentiation of the magma from which they were derived, together with differences in the conditions under which the differentiated parts of this magma were cooled. Their chemical peculiarities are the direct result of the chemical nature of the homogeneous magma before its differentiation into parts. If this notion is correct, the succession of products originating during the course of a volcanic extrusion should be "from a rock of average composition through siliceous and more siliceous ones to rocks extremely low in silica and others extremely high in silica, that is, the series commences with a mean and ends with extremes."

It will be the endeavor to discover whether this law of succession expresses the facts in the case or not, that will advance the science of petrography to that of petrology. If Mr. Innings's law of succession is found to hold, the future classification of rocks will be based upon the principle of consanguinity: there will be grouped in the same great division types of different mineralogical composition and of different structure, while the different great divisions will be based primarily upon chemical considerations. What these chemical considerations are to be it is difficult at present to foresee.

Whatever may be the future classification of rocks, however, it is quite certain that petrographers are in the main right in distinguishing between rocks of different structures and different mineralogical composition by different names. There is a fashionable tendency apparent among English and American petrographers to decry the habit of naming these slight differences, not because the number of rock-types in nature is in reality small, but simply because the terminology of petrography by the addition of these names becomes large — as if we could increase the simplicity of the science by refusing names to the objects of whose study it consists. The same tendency has been observed also in the history of chemistry. Some inorganic chemists have objected seriously to the introduction of the many new terms into organic chemistry, and yet nothing has done more to advance this particular phase of the science than its system of nomenclature. It is easily understood why *geologists* should object to the increase in rock names, since this increase necessitates a greater amount of labor upon their part in becoming acquainted with the terms. But why *petrographers* should object to a more accurate designation of the objects of their study is not understandable. It would seem to the writer that for petrographical purposes every rock-type that differs in some one essential feature from all other rock-types should receive a distinctive name, in order that its differences might be emphasized. If all the types with major characteristics in common should be grouped under the same name, we should lose sight entirely of their minor characteristics that may be exceedingly important as throwing light on the relation of composition and structure to the conditions under which the rocks were formed. Again, it is much more convenient to speak of a keratophyre than of a "granophyric granite differing from ordinary granophyre in the possession of anorthoclase instead of orthoclase." This difference between keratophyre and granophyre, though of insignificant importance from the point of view of the geologist, ought to be of considerable importance to the specialist in rocks. It may express simply a difference in the original constitution of the magma from which the rock was formed, or it may be the expression of peculiar conditions under which solidification took place. In either case the difference is of importance and should be emphasized.

It would appear that the difficulty to the geologist of acquainting himself with the complete terminology of petrography might be avoided by grouping rocks in accordance with their chemical composition and structural *similarities*, and by dividing the groups according to the *differences* prevailing among their members. Geologists need take account merely of the great groups, while petrographers would require to become acquainted with their subdivisions.

In denying the necessity of expressing in their names the comparatively slight differences noted between many rocks, it will not do to say that petrography is simply a branch of geology and that there is no room for the study apart from geology. The methods of petrography are entirely different from those of geology; in many cases they are as different from those of the last-named science as are those of paleontology. Petrography is the special science dealing with some of the materials of geology. Unless it is recognized as distinct from geology it will never become of the importance that it will otherwise assume, and cannot aid geology as it should do. If it be regarded as something worthy of study for its own sake, then it is necessary to label the objects of its study so that they may be handled conveniently,

[1] The Eruptive Rocks of Electric Peak and Sepulchre Mountain, Yellowstone National Park. 12th Ann. Rep. Director U. S. Geol. Survey, p. 569.

and it is advisable to express as much in the labels as may suffice for a pretty complete knowledge of the objects labeled. If this notion is a correct one, let us welcome the designation of *differences* in rocks by their names, and not seek to lose sight of these differences in contemplating simply likenesses. On the other hand, it is well to exercise care in the selection of types to be named, so as to avoid as far as possible the lumbering of the terminology with needless expressions. Discrimination must, of course, be exercised in the naming of types, and experience must decide as to the value of any proposed name. The writer would prefer that the *varietal* names should be based upon mineralogical composition, and that adjectives should express the structural *differences*, where the structure of the variety departs from the characteristic structure of the group.

CLOUD CLASSIFICATION.

BY CAPT. DAVID WILSON-BARKER, R.N., H.M.S. "WORCESTER," ENGLAND.

FOR some years meteorologists have been in doubt as to the nomenclature of clouds, greatly to the retardment of this important and practical branch of the science. The nomenclature of Luke Howard answered very well for a time, but with our advanced knowledge it scarcely answers at all. It is not simple enough for beginners, nor elaborate enough for those well advanced. Many of the systems proposed lately are simply modifications of this old nomenclature, and retain its faults. Unfortunately, in cloud classification we are met with many difficulties at the outset, we cannot collect and label clouds in a cabinet for reference, but here photography may aid us much. From personal experience it has been found quite possible to portray even the most delicate and fleecy clouds with sufficient accuracy to leave no doubt as to their type. It is proposed in this article to lay before the readers of *Science* a simple scheme of cloud nomenclature suitable for beginners and those unable to devote much time to the study. On this simple scheme can be founded a more elaborate system for skilled nephologists.

It will soon strike any one who notices weather phenomena ever so casually, that clouds have a tendency to assume one of two well-known forms or shapes, either a heapy or globular form, or that of thin sheets or layers. Clouds in the first form are known as cumulus (cumulus, a heap) clouds. In the second as stratus (stratus, a layer) clouds. Once it is clearly understood that all clouds be divided into these two types as a starting-point, and belong to one or other of these types, the question of a minute sub-division becomes, comparatively speaking, easy.

It may be well to give here a cloud definition. *A cloud is vapor, which has ascended or descended in the atmosphere from a position having a temperature or density greater than the portion of the atmosphere it ascends or descends to, which is then unable to retain it in its invisible form. According to the physical state of the position it is attracted to, so will be the form it will assume on becoming condensed.* It will be seen from this that the shape of a cloud is more or less determined by its physical surroundings, and consequently it affords a valuable index, not only to the state of the immediately surrounding atmosphere, but also to the weather we may expect, and this frequently some time before any instrumental warnings are indicated.

Cumulus is essentially the cloud of the lower atmosphere, as, although it sometimes tops to great altitudes, yet its formation commences at a, comparatively speaking, low level. Cumulus clouds assume varied and fantastic shapes, and vary very often from clouds of enormous extent to small nubecules, still there is in them a distinct and marked similarity, which must be easily recognized. There are three forms of cumulus clouds from which rain falls, viz.: 1. Bold, massive cumulus with feathery tops, which appear to be composed of ice crystals, and are like the high variety of stratus known as cirrus; 2. bold, massive cumulus with all clearly defined borders, only seen in the tropics; 3. fleecy, ill-defined cumulus. The first may be accompanied by either snow, hail, or rain, with a decided increase of wind, and, in fact, is a squall, which often gives warning hours before it reaches the observer. In the second is heavy rain with little increase of wind-force, and at sea is the kind of cloud which sometimes accompanies waterspouts; and the last has only drizzling rain and no increase in wind-force.

Stratus is formed in all layers of the atmosphere. On the ground it is fog, in the lower atmosphere as covering the sky oftentimes for days in anticyclone areas; in the middle layers in broken-up or more or less circular patches constantly, though erroneously, called cirro-cumulus or cumulo-cirrus, and in the highest layers as the well-known cirrus or curl-cloud. It is the cloud of the finest settled weather, and also of the front of cyclonic disturbances, but there can be no mistaking these two conditions. In the former case, it forms a pall over the whole sky, perhaps broken here and there by a rift, through which a blue sky, quite free from other clouds, may be seen, and appearing in all directions in lines parallel to the horizon. The first sign of any change is preceded by the disappearance of this cloud, and the formation of fine threads of cirrus over the sky; these threads gradually grow closer and closer together until the sun or moon shines through surrounded by a halo. As the cloud gets thicker (seems to grow in the air) this too disappears, rain begins to fall, and a cyclonic disturbance is well under way. In the first case the stratus was in the form of a cloud of great superficial extent and small depth, in the second it has great depth and uniformity of texture.

Cloud observing is a difficult branch of meteorology, yet no great advances can be made in the physics of the atmosphere until we have a better knowledge of its movements, and this article is written in the hope that those interested in the subject may not be appalled by the apparently hopeless condition of cloud nomenclature. For if we could have a series of observations taken carefully on even this simple basis, they would be of more value than the majority of observations taken now; and this especially applies to observations at sea, as it is to the sea we must look for the most valuable meteorological observations. Personal experience has shown that observers, while finding it comparatively easy to distinguish between cumuliform clouds and stratiform clouds and the different altitudes at which they float, yet often make great mistakes when they have to deal with the subdivisions as they are at present determined.

NOTES AND NEWS.

FIVE lectures on anthropology are to be given on Monday afternoons by Daniel G. Brinton, M.D., LL.D., at the Philadelphia Academy of Natural Sciences, admission free. Tickets can be obtained at the Academy from Dr. E. J. Nolan, secretary. Feb. 13, The Bonds of Social Life; Feb. 20, The Growth of the Arts; Feb. 27, The Progress of Religions; Mar. 6, Language and Literature; Mar. 13, Folk-Lore, or the Past in the Present.

— The Royal Academy of Sciences of Turin announces that the ninth Bressa Prize, consisting of 10,416 francs, will be awarded to any scientific author or discoverer who, during the years 1891–94, shall, in the judgment of the Academy, have made the most important or useful discovery or published the most valuable work on physical and experimental science, natural history, mathematics, chemistry, physiology, and pathology, as well as geology, history, geography, and statistics.

— From the American Book Company we have received the four latest volumes of their English Classics for Schools. They are: "Ivanhoe," by Sir Walter Scott (484 pages, 50 cents); "Julius Cæsar," by Shakespeare (114 pages, 20 cents); "Ten Selections from the Sketch-Book," from Washington Irving (149 pages, 20 cents); and "The Sir Roger de Coverley Papers," from the *Spectator*, by Addison, Steele, and Budgell (148 pages, 20 cents). The first-named volume is provided with a serviceable glossary, and all are well printed, on good paper, and are neatly bound.

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THE MIOCENE GROUP OF ALABAMA.[1]

BY LAWRENCE C. JOHNSON.

FIVE or six years ago it was doubtful if the Gulf States had any well-defined Miocene. The brilliant discoveries of Mr. D. W. Langdon, at Chattahoochee and at Alum Bluff on the Apalachicola, set that question at rest for Florida; still there was general doubt of any extension of the same into Alabama.

Dr. Eug. W. Hilgard had defined and located the Grand-Gulf Group in Mississippi, and conjectured it might be Miocene. But he was not perfectly satisfied, and for want of fossils no paleontologist would undertake a decision. This also it would have been bold a few years ago to say had any continuation into Alabama.

Whilst at work for the U. S. Geol. Survey (1889), the Grand Gulf was explored, to a considerable extent, in Louisiana, Mississippi, and Alabama.

Dr. Hilgard, for Mississippi, divided it lithologically into two phases: the first well seen at Grand Gulf, in which quartzites prevail; the second, most abundant, has the peculiar, characteristic silicious clay-stones, found in such masses nowhere outside of this group.

It was the fortune of the writer to observe two other phases in Mississippi:

(1) The quartzitic phase — being only a phase of the next — roughly estimated, extends from the north-west corner of the formation on Big Black River, to a curved line drawn across from Rodney to Pelahatchie. It is most largely developed on Bayou Pierre and Cole's Creek. For convenience it may be called the "Bayou Pierre Phase."

(2) The second, having very irregular boundaries, may have its southern line drawn from Tunica, in Louisiana, by Columbia, Miss., by the mouth of Okatoma Creek, by the Falls on Leaf River near Estabuchie, passing to the southward of Ellisville and crossing Chickasawhay River between Winchester and Waynesboro. For convenience this division will be called the Fort Adams, or the Ellisville phase.

(3) More remote from the Great River, and southing farther, the less silicious the formation becomes, at Hattiesburg, and on that part of Leaf River from Okatoma to Rogers' Creek, and on Chickasawhay above Leakesville, a third phase is exhibited, abounding in phytogene remains — almost lignitic. This is the Hattiesburg phase or formation.

(4) A fourth manifests itself below Leakesville on the Chickasawhay, on the Lower Leaf River and Pascagoula — being clays of a more tenaceous quality — abounding in specks and nodules of calcareous material, and in a few places holding shells of mollusks. One locality of the last, where first discovered, is the Shell Landing below Roberts' Bluff, four miles south-west of Vernal postoffice. This is the Pascagoula phase or formation.

The last three extend into Alabama, though the fourth lies so deep under the great ridge of sands of Mobile County that no overland outcrop has yet been discovered. In the deep boring at Mobile it was reached at about 600 feet. The shells of the boring have been pronounced by Dr. Dall identical with those of Pascagoula, and a list of them furnished by him in this journal, Sept. 16, 1892.

The second and third phases have been traced across Alabama. The second is finely developed at Healing Springs, in the northern part of Washington County. Briar Creek is about the boundary between it and the Eocene, and southward of that it is frequently exposed by the washing away of the surface sands, as far as the head-waters of Bilbo Creek.

The southern part of Washington is underlaid by the Hattiesburg — the third phase. Many of the shallow ponds and cold clay flats are to be accounted for by this fact; and so are the ridges of better soil. Lignitic spots, coming to the surface where drainage is sufficient, have weathered into limited areas of better soil. Such a spot is on the southern branches of Basset Creek, on the St. Stephens and State Line road.

Baldwin and Escambia counties afford a continuation of these parallel lines of silicious clay-stones, of ponds, and of cold clay flats — not without places of better soil. This is the true origin of the well-known strip of red lands on the high ridges northward of Williams and Canoe stations — up West Escambia.

Finally, in the vicinity of Brewton, Burnt Corn, Murder Creek, and Conecuh River, expose sufficient of these three older phases of the Grand Gulf as to leave no doubt with regard to the horizon to which it properly belongs.

Chalk Hill, at N. B. Dixon's (Sec. 1, T. 2, N. of R., 13 E), is a repetition of Chalk Hill at Healing Springs, while the hills near Castleberry on Murder Creek (Sec. 1, T. 2, N. of R., 10 E.), and the exposures on Conecuh at Silas Bluff (Sec. 6 and 7, T. 1, N. R., 13 E.), at Coal Bluff (Sec. 7, T. 1, N. R., 11 E.), and at Roberts, Silas Creek (Sec. 5, T. 1, R. 12 E.) display the Hattiesburg phytogene phase as fairly as Augusta on Leaf River,— with the addition of molluscan fossils not found in Mississippi. These are only in casts, true: because the clay-sandy material, without lime, was too porous to retain calcareous shells.

Of the precise type and horizon of these fossils we are not left in doubt; but to marshal our testimony on the subject, it will be necessary to step across the line, and to bring forward by continuity the Miocene Marls of Florida, to wed these Grand-Gulf clays of Escambia.

II. Wakulla Springs, in the county of the same name, has a peculiar limestone, which is found from St. Mark's Bay into Georgia. Generally fossils are few. The great coral, *Astræa Floridana* or *belea*, and *Orbitolites Floridana*, ever present in these warm sea-formations, are among them. In the deep excavation at Weelaunee, Jefferson County, and the Bloxham well near Tallahassee, fossils are more numerous and of greater variety.

On the Chattahoochee River, at Rock Island, between Port Jackson and the mouth of Flint River, the Wakulla rocks again manifest themselves, and upon the Eocene Vicksburg limestones of Jackson County. Below the mouth of Flint, at the village Chattahoochee, and forming the left bank of the Apalachicola to Aspalaga landing — ten miles — is another phase of the older Miocene.

On Chipola River, at and above Chipola postoffice, is another phase of the older Miocene — the Chipola beds. These lie in and upon the Chattahoochee more silicious form, in which the fossils are very obscure. In the more calcareous ferruginous deposits of Chipola, Farley Creek, and Ten-mile Creek, they are the best preserved in the world. Even the Orbitolites are perfect, instead of a mere impression. Neither of these formations can be said to cross the Choctawhatchee River, westward. The obscurely fossiliferous sandy rocks of Econfina, and at Douglas Ferry on the Choctawhatchee, may be assigned to the Chattahoochee. But west of that great river the territory which should be occu-

[1] Recent investigations made by Lawrence C. Johnson, for the Geological Survey of Alabama, published in advance of the General Report, by permission of Dr. Eug. A. Smith, the Director.

pied by the older Miocene, is usurped by a long synclinal valley, which is overwhelmed by deep sands. Upon the maps this syncline is easily followed by Sandy Creek and the upper waters of Shoal River. From the bend of the latter the syncline crosses to the Yellow River and takes the whole valley of Black-water north of Otaheite.

The great roll, or anticline, forming the southern and western limits of this syncline, may be easily followed westward from Alum Bluff, by Abes Spring — crossing Choctawhatchee at Knox Hill — and forms the high ridge upon which Defuniak is located. It is cut through by Shoal River at the high hills or bluffs between the Wise Bridge and Christmas Bluff, and by Yellow River at Hickman Bluff, above the railroad, and subsiding below the same southward to Daw's Bluff and northward to Oak Grove, whence fifteen or twenty miles of the river is in the trough of the syncline, the very region where the older Miocene should be found, if continued west of Econfina River.

Walton County, West Florida, is traversed by some considerable streams, which have removed in places the superficial Orange Sands, and cut deep into fossiliferous beds, on Yellow River, Shoal River (lower part), Alaqua, and Blairs Creek or Euchee.

Christmas Bluff — an almost inaccessible locality in the vicinity of Taylor's Mill, to the north of Mossy Head, is perhaps the best for the amount of the exposure — there being sixty feet from the water to the Orange Sand of the ridge above — twenty feet of the top being calcareous and full of the finest shells. The lower forty feet of the bluff seem to be without fossils, at least none were discovered at the brief visit of 1889. The compact sands of this lower part of the bluff strongly resembled those at the base of Silas Bluff on Conecuh River, and still more the sands at the head of Ten-mile Creek, and on Econfina in Calhoun County, Fla. In the last, however, were impressions of fossils, which connected it with the Chattahoochee Formation.

At no one of the many localities exposing fossils could all the phases of these formations be seen. Alum Bluff comes the nearest to this requirement; yet it is best to study them where more widely parted and where each may have scope for a grander display.

Such typical localities may be found on the two neighboring creeks, Alaqua and Euchee, south of and very near to Defuniak Springs.

The phase seen near Euchee Ana consists of a sandy ferruginous clay, calcareous in spots, having innumerable shells and casts of the small *Mactra congesta*, mixed with or finished off at the top with a good deal of silicified wood and lignitic matter. This is the counterpart of the topmost layers at Alum Bluff and of the lowest bluff at Abes Spring on Chipola.

The Alaqua phase, on the other hand, has the larger shells — *Conchs Cardiums, Arcas Pectunculus*, etc., in good variety, and a fine state of preservation. This is the formation of the upper bluffs at Abes Spring. In fact, Chipola River affords the finest opportunity for the study of all the phases of the Miocene with exception perhaps of the Wakulla rocks. There is at the Abe Spring lowest bluff more than 100 feet longitudinally of the Euchee phase, above that more than a mile of the Alaqua phase, culminating in a 60-foot bluff at the Darling Slide, and above that for eight miles are the Red Orthotax beds, and gray allied calcareous sands up to "Look and Trimble" shoals of the more indurated Chattahoochee form.

The Alaqua phase the writer learned from Mr. N. H. Darton, whom he met in Florida soon after the discovery, to regard as equivalent to his Chesapeake. The more complete studies of Dr. W. H. Dall, it appears, led him later to the same conclusion.

The younger Miocene, of the Alaqua type at least, is perfectly and largely developed on the bluffs of Yellow River, from the Alabama line to Milligen in Florida, the most northern of these beds being the low shell landing at Oak Grove, six miles south of the line.

Twenty miles north-west of Oak Grove, and across the deep sands of the synclinal valley of Black Water, the great anticlinal roll reaches Conecuh River. At Roberts, on the head of Silas Creek, the bluff washed out by the waste-way of the mill is filled with casts of the same Alaqua fossils. The clay and wood and lignitic matter of the upper part of this wash-out bluff seem identical with Coal Bluff, six miles to the south-west. No fossils are found at the Silas Bluff, though so near; and there is no reason to doubt that the lower strata of Silas are identical with the outcrop at Dixon's Chalk Hill, six miles further north, and 100 feet higher hypsometrically, — that is the same as the older underlying Grand Gulf quartzitic clays and rocks, — neither should it be doubted that these are equivalent to the calcareous clays of the Chattahoochee formation — in time. That these in precise mode and form did not pass this far west is in perfect harmony and accord with the geological history of the region.

III. In time of the older Miocene, all of Florida above water was an archipelago of small Eocene islands, located where now are the counties Suwanee, Fayette, Columbia, Alachua, Levy, Marion, Hernando, Citeus, Pasco, and Sumter, — or rather parts of them, — and there were probably a comparatively deep strait and strong current between them and the Eocene rocks of the same age in Georgia. Dr. Dall has shown by the fossils that this channel of the older Miocene period was a warm-water sea.

In this warm-water channel was laid the Wakulla rocks of the county of that name, of Jefferson, of Leon, and of Jackson, underlying the Chattahoochee beds.

Now observe upon a map how the Eocene of Jackson and Holmes extends southward to Orange Hill in Washington County, which rises boldly above the waters of the low country a height of some 200 feet. In Miocene time this must have been a notable promontory, jutting out into the shallow seas. It is not probable that the warm currents of the great bight of Georgia, either at ebb or flow, had much force to the westward of Orange Cape, and the cold waters of the Mississippi embayment, as reasoned by the same authority, reinforced by the rivers of Alabama, creeping along through estuaries, were very unfavorable to molluscan life. For which reasons, when by position and continuity, the rocks of Wakulla and of Chattahoochee shall have been traced westward of Orange Hill, it is not to be expected the fossils of *Weelaumee* and of the Red-beds will be found therein.

There remain now only two other formations, not collated and accounted for — the Pascagoula clays and the Euchee phase of the younger Miocene.

So far as known, the Euchee stops abruptly at Daw's Bluff below Milligen. This part of Santa Rosa County is depressed, whether by subsidence or by denudation does not as yet appear. By position it might be assumed that the Euchee is to the east the equivalent of the Pascagoula of the west. But the fossils are not the same; neither is it probable that the circumstances of genesis were the same in both. Proximity to the Great River rendered the laying down of every phase of the Grand Gulf unique on this continent.

Both the Pascagoula and the Euchee were estuary so far as they agree, and it is possible the small *Mactras* to the east were the representatives of the still less marine Guathodons of the west. It is said the living *Guathodon cyrenoides* of our coast is not at present found east of Mobile Bay, but the writer has found them in Kitchen-middens on Choctawhatchee Bay, in the waters of which they and the oysters are now both said to be wanting. If not exactly equivalent, both these stand in the several regions to which they belong as the youngest known formations of this Miocene group.

THE SCIENTIFIC ASPECT OF THE UNIVERSITY SETTLEMENT MOVEMENT.

BY FREDERIC A. C. PERRINE, D.SC., BOSTON, MASS.

Of the social work in our great cities by philanthropists and churchmen, there is undoubtedly a considerable proportion unfortunately carried on in such a casual manner as to afford only pain to one trained in habits of scientific investigation and scientific caution in action. Many charitably-aimed movements have been proven to be the greatest practical failures and, in spite of the high-minded intentions of their progenitors, stand con-

demned at that highest of courts which demands fruits for judgment.

It must, therefore, be a relief to the minds of those having a knowledge of the need for social effort and at the same time a conception of the value of true scientific methods in such effort to know that there is at present being developed a movement having for its principle aim the general solution of the problems attacked in the light of a scientific study of the conditions and the elements actually involved in the various problems as presented in the lives of our municipal communities.

This movement to which we refer, the University Settlement effort, came originally from Oxford and was the practical suggestion of Arnold Toynbee, for whom the great settlement of London has been named and from whom came the inspiration of the workers in this and other countries.

To solve the problem of heat and light or electricity while being shut out from a possible knowledge of the facts involved or a possibility of experimenting with those forces we would to-day consider to be the height of intellectual absurdity and worthy only of the *a priori* philosophers of the Middle Ages, whose opinions are of value only as curiosities.

Or once having exactly ascertained the existence and the laws of physical phenomena and not to attempt to make use of our knowledge for the practical advancement of life upon the globe and for progress in the arts we are bound to regard as lack of enterprise and the spirit of ultimate scientific progress.

But in the so-called "Social Sciences" and their application we are only gradually adopting the inductive method for gaining knowledge and have been devoting more time to the attempted ultimate solution of fundamental problems on insufficient premises than to the practical application of such knowledge as we have already gained and the actual face to face study of the conditions for the discovery of future data.

With the sense of this lack of scientific method in the study of our social questions and the feeling of urgency in the necessity for the application of such truths as we have already obtained, the men and women of the University Settlements have established, in several of our great cities, houses, to be centres for work, set down in the midst of the conditions which are to be investigated and acted upon.

While many of the people who have taken up this work are undoubtedly so directed from their affiliation with the Church and its efforts for regeneration, the methods used are essentially foreign to what has been known as "Church work," and their aim is very far from being along the lines of attacking the problems which are purely physical from the spiritual standpoint. But striking out along the grand lines of the early development of altruism from egoism though the fellow feeling for those with whom we are in personal contact, they have adopted the idea of the self-help of a neighborhood as their governing principle. With this moving principle in view the University Settlement movement is easily understood.

Primarily it is, by bringing to the view of what has been called the "submerged tenth" the lives of those successful in the battle for contentment in life through higher ideals and greater education, to create a feeling of dissatisfaction with surroundings not typifying those ideals and to open to their minds the possibility of progress through advancement in knowledge and the attitude of mind which is not content with the creature means of existence, and, as neighbors, to help all such as have already gained a desire to become more worthy citizens, men and women. As a means for such influence the work of the settlement in visiting, clubs, classes, and all kindly actions is instituted.

For those beyond the possibility of these influence, and even beyond the effect of any efforts made for social regeneration, the situation in the midst of such classes offers a possibility for the study of the conditions and the internal life and movement of the subjects to be acted upon. Studies have begun in the collection of facts and phenomena which gradually but only gradually develop the laws of social dynamics and social statics which have been so often approached from the theoretical but so seldom from the standpoint of induction and experiment.

As the facts are discovered and these laws developed the personal relations of the workers in such fields must yield to their minds the true methods of attacking and solving the problems which perhaps only first in these studies have been presented and enable them to point out to individual workers as well as to municipalities the directions of sure progress

Not by any means the least productive effort of the settlement is this unification of the direction of the efforts which various social workers have been making towards a greater advance in economic progress and the bringing of the various classes of the community into harmony with each other.

There is no one that will doubt that a common humanity actuates us all, but it is at the same time impossible to say that there is a comprehension of this fact in the minds of the individuals belonging to the several classes.

While our origin and essential characteristics may be identical, it is nevertheless true that the variations in the external conditions have so far led us to apparent hostility that the fact that there is a common point of interest has become almost completely extinguished.

Here lies the dangerous element in the growing movement towards the usurpation of the rights of the individual by the community, for on both sides there always remains a fear of oppression and of usurpation of power by the other. To counteract such a dangerous principle, in either its idea or its application, it has become more and more necessary that our heterogeneous communities should come to a knowledge of their essentially homogeneous character, a knowledge which must rest upon firmer foundations than the mere intellectual conception of a truth and be guarded in a trust across the social barriers, only to be gained by a more intimate knowledge of each other's characteristics as well as each other's conditions of life.

By the studies we are describing the knowledge necessary is gradually being obtained, and the trust accorded by both sides to these students renders possible an actual contact from one side to the other and brings about a trust in the hearts and characteristics of men separated by the wide gulfs of circumstance. Studies such as these are developing, too, the manner of education needed for the most rapid advancement of the community, settling many disputed questions of the bearings on the lives of the people of manual training, day-nurseries, model tenements, boys' clubs, and other similar efforts which have been made from above downward, based on theories founded too often on insufficient knowledge of the facts involved and carried along with too little regard for the actual results attained.

We may, in consequence, expect from this movement a fruit of knowledge gained of social conditions and the results of sociological experiments which, while being of the character of the ascertainment of scientific facts obtained through a scientific method of investigation, yet carries with it practical results in the advancement of the life of the community toward a more rational fitness to the environment and a healthy improvement in the material conditions and culture of great masses of the community.

A NEW VISUAL ILLUSION.

BY EDMUND C. SANFORD, CLARK UNIVERSITY, WORCESTER, MASS.

THE following illusion is, so far as I know, new and seems of sufficient interest to put on record. A short-pointed star of white card-board, or even a square, is placed on the spindle of a rotation color-mixer and set in rapid rotation. The resulting appearance is a white central circle surrounded by a transparent ring — most transparent at the outer edge, least transparent toward the centre. If now a piece of black card-board of a length somewhat greater than the diameter of the star from point to point be brought behind it while in rotation, the advance of the edge of the card can be followed, not only behind the transparent ring, *but also behind the opaque central circle.* It is most noticeable just within the circumference of the central circle, and is most marked when the black card is kept in motion. When the card remains stationary, the illusion weakens; and for perfectly stationary objects, like the parts of the rotation apparatus itself, it fails altogether. The portion of the central circle, through which the card seems to be

seen, is also appreciably darkened by its presence. When the star is black and the card behind it white, the illusion is still present, though a brightening of the black takes the place of the darkening just mentioned.

The rationale of the illusion is easy. The outer ring is really transparent, and the edge of the card is really seen through it. The transparency of the ring strongly suggests the transparency of the centre, a suggestion that we accept the more easily because the rapid rotation changes the appearance of the central portion somewhat from its familiar resting appearance. The apparent darkening of the portion of the central part overlying the black card is to be similarly explained. It is especially interesting, however, as being clearly a psychological illusion, an "illusion of judgment," while the color illusions formerly so called are being shown to be physiological, and largely, if not entirely, due to the mutual influence of adjacent portions of the retina.

A physiological explanation of this illusion seems hardly possible; and its psychical character is further attested by the ease with which it is corrected when the card remains stationary, and the unequal degree in which it seems to affect different observers.

A SUGGESTION AS TO TOPOGRAPHIC MAPS.

BY ARTHUR P. DAVIS, LOS ANGELES, CALIFORNIA.

WHILE the scientific and technical bodies of California and other States are agitating the question of topographic maps, educating the public on the question, and endeavoring to secure State appropriations and Government coöperation for such surveys, it may not be amiss to suggest other sources that might be made to furnish valuable contributions toward the same end. I refer to the very extensive and costly surveys made by engineers, promoters, and companies to determine the necessary information for the construction of railroads, irrigation systems, etc.

I have known cases where a large number of preliminary or trial lines have been run, the aggregate cost of which amounted to many times that of a good topographic map of the region under investigation, which would have shown all that the afore said surveys can show, and a great deal beside; for it is always an open question, whether the line finally determined upon is in reality the best in all respects, or whether some other, of the many untried possible routes might not be somewhat better or cheaper. All these possible routes would be shown by a good contour topographic map, and in addition thereto it would serve as a valuable piece of data for any future additions or alterations in the work.

Another argument in favor of the contour map that ought to weigh strongly in its favor with the persons above referred to, is the philanthropic one, that such a map is a valuable and permanent contribution to science. A large percentage of the scientific discoveries that have contributed so prodigiously to the intellectual and material advancement of the human race, have been made by persons working without the incentive of financial gain, and it is safe to say that few of them would have been made, if that had been the only incentive followed.

I do not believe that engineers and capitalists in charge would prove less public spirited than others if their attention were properly directed to this matter; and if geologists and others actively interested would persistently present these facts to the proper persons, great good might result. The main point to be carried is the substitution of the plane table for the transit in making preliminary surveys.

Without a systematic method of accurate field-sketching, which is the essential principle of the plane table, topographic mapping on any extended scale is impossible. Properly handled, with triangulations to check locations, and level bench-marks to check elevations, and with stadia to assist in sketching, plane table work may be entirely accurate within any scale adopted, and serve not only for preliminary information upon which to locate routes for canals, railroads, etc., but is a permanent record of comprehensive information to guide all future engineering operations in the country included, so that ordinarily at least two or three times as much might be advantageously spent on the construction of contour maps as would be required for running preliminary lines, and still the company would profit by the substitution. If the labor expended upon the tremendous mass of material now on record in the great engineering offices throughout the west had been judiciously supplemented by field-sketching on the plane table, a very great addition would have been made to our topographic knowledge, and I believe that such results could be brought about by well-directed efforts on the part of the proper persons.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Pseudoauroræ.

DR. HATCH'S description of "Pseudoaurora Borealis" in your issue of Dec. 2, 1892, calls to mind a peculiar phenomenon which I once witnessed here, and which may have some bearing on pseudoauroræ in general if not on the particular species observed by Dr. Hatch.

About three years ago, as I was returning from the business part of the village of Plattsburgh, N. Y., my attention was taken by two long, white, brilliant, quivering streamers in the south-west, which at times seemed to shoot up and nearly reach the zenith. This was an unusual direction for such a display, and I at once turned toward the north to note its character there. Buildings prevented a good view, but I saw several streamers though none so brilliant as those in the south-west. Hastily taking the phenomenon for a true display of the aurora, I hurried home, only noting on my way that the streamers were brighter now in one direction, and now in another. It was not until I had called others out to witness the display, and remained quiet myself for a moment, that I discovered that one very brilliant streamer seemed to be situated directly back of the known position of one of our arc lamps, and what was still more curious it refused to move from that suspicious position. This streamer varied remarkably in brightness, now being short and faint, and again long and brilliant. Along with these greater changes in intensity there were more rapid and lesser changes, and in addition to these a constant shimmering of the light. There were also slow wave-movements of brighter portions which ran from below upward, or crossed the streamer from left to right. It was movements of this nature, so like the curtain movements of the true aurora, that led me for the moment to refer the phenomenon to the aurora itself, and the many beams, which sometimes ran so high as to suggest a corona overhead, and which varied in relative intensity if one was moving about, only helped to confirm the error. Plattsburgh has had electric street-lamps for seven years or more, yet this one display stands practically alone by itself. The streamer which I studied most was over a lamp something more than a thousand feet away, and was viewed across some village lots with many buildings clustered around the position of the lamp. The lamp itself was thus hidden from view, though it hung over the centre of the street and could cast no high shadows save alone those of the top of the lamp and its wires. These, of course, helped to cut up the beam of light. I do not think that a dark arch was present, though I can conceive that one of Professor Hazen's shadows might have been thrown by a group of trees or buildings in such a manner as to produce one, had some convenient cloud been situated in the background. I attribute the phenomenon to the peculiar condition of the atmosphere at the time. We were in a very light frost-fog and the vertical and lateral movements of brighter waves were probably due to denser portions of this frost-cloud, drifting along with the air-currents. The varying light of the arc lamps served to make these movements seem the more complex. I think it very probable that color was in many places present, due to a halo encircling each lamp, although I do not recall having noticed it. From Dr. Hatch's description it would seem that the two phenomena are not the same, as when he retired from the lamps the "aurora"

vanished, yet the phenomena I have described were seen from quite a distance, although if I moved about the streamers changed in relative brilliancy. I have many times thought of this appearance when I have looked over published reports of auroræ from voluntary observers, and it may be well to show that all unusual night-lights are not auroræ.

From Dr. Hatch's proximity to the lamp, "about the angle of 60° to the burner" (is this altitude, zenith distance, or an angle measured from some street lines?), it may be possible that his phenomenon has some relation to the halos which may be frequently seen around the arc lamps here. When near the lamps the halo is small and, under proper atmospheric conditions, very brightly colored; at a greater distance the halo is larger but the colors not so distinct. In either case if you can witness the upper half of this halo *as if it were on the celestial sphere*, you will have a large "luminous arch" "consisting of pencils of light radiating upward from a dark arc, . . . the pencils constantly changing in length, and having an apparent movement laterally" if the head is moved in the least while noting different portions of the arch. The "coloration of the pencils" will be also "unmistakable." See Dr. Hatch's reply to Professor Hazen in *Science* for Jan. 20, 1893.

GEORGE H. HUDSON.
Vice-Principal State Normal and Training School, Plattsburgh, N. Y.

Continuous Rain.

A REMARKABLE phenomenon was observed in the town of Athens, Ohio, late in the fall, which has awakened wide interest, viz., continuous rain during a succession of clear, beautiful days. This was noticed extending for a considerable distance just below the crest of a hill, and lasted through the day, from soon after sunrise till about sunset. The drops of water were at no time large, but they reached their maximum size about two or three o'clock in the afternoon.

The subject attracted the attention of professors in the Ohio University, and it was soon determined that the phenomenon must be due to the precipitation of vapor which had been carried through an old railroad cut for several hundred yards. There had recently been completed and set in operation extensive brick-works, where three large ovens were continually in operation, and from which hot currents of air steadily shot upwards. In the moulding of the bricks, water is mixed with clay, and an enormous amount of hot, watery vapor was passing into the air above the ovens, supplemented by large quantities from the stacks of a large "dryer," which was kept at a high temperature. It is estimated that in all fully forty-five tons of water were at this season daily evaporated.

The plant is situated in the valley of the Hockhocking River, close to a cut made many years ago for a projected railroad, and this cut leads directly to the rise of land where the observations were made. The observer at the University Weather Station reports that the prevailing wind was at this time in a direction such as would carry the hot air, laden with moisture, through this artificial passage. The air was, in all probability, carried partly up the hill and there dissipated along the side. About this time it must have come in contact with a cold current near the crest of the hill, and precipitation followed, causing this unusual rainfall. The conclusion that the precipitation was due to these causes is strengthened by the fact that not until the manufacture of bricks at this place was begun was any such phenomenon observed, so far as is known.

H. E. CHAPIN.
Ohio University, Columbus, Ohio.

Natural Selection at Fault.

IN the issue of *Science* for Jan. 20 there appears, under the above heading, an article from the pen of J. W. Slater. The conclusions there arrived at do not necessarily follow from the facts cited. That animals of the Felidæ by tormenting and playing with their victims often lose their prey, which otherwise might have been devoured, is well known to every observer. The facts, however, that this is most frequently done by the younger animals, and generally at a time when they are not greatly in need of food, are overlooked. Besides, what seems to be the most important consideration in the case, is that by means of this play that quickness and precision of motion so essential to success in procuring food are acquired, so that doubtless the gain in the end is much greater than the temporary loss occasioned by the accidental escape of a victim now and again.

In reference to the cackling of the hen, it may be that this animal has been so long domesticated that it is impossible to draw inferences with any degree of certainty from its conduct in this respect. Every house-wife, though, who has kept hens, is well aware that their cackle is very deceptive, that it is generally not commenced till they have got a little distance from the nest, and may, very likely, in most cases, serve to attract attention to themselves and away from their nests. Several of the wild birds that nest on or near the ground, when suddenly disturbed, escape in a manner evidently intended to attract attention to themselves and away from their brood. The action of the domestic hen may generally serve a similar purpose, and yet at times fail or even produce an opposite result.

Neither does it appear that the human ear is any more a case in fault. The principle of natural selection does not necessarily require the loss of a useless member unless it is positively injurious — a hindrance in the struggle for existance. The outer ear is not that; it may even serve a purpose. Writers on acoustics tell us that it serves to some extent to condense or concentrate the sound-waves. Even if it serves no other purpose than to improve the personal appearance, its retention would still be in perfect accord with the theory of natural selection.

Besides, it cannot be shown that the human ear is not now undergoing a process of atrophy. Grant that the outer ear has been of no use to our fathers for many generations, it would not necessarily follow that children of to-day should be born earless. All evidence goes to show that changes of this character are so gradual as to escape notice. The fact mentioned by Mr. Slater, that, owing to disuse, the outer ear has lost its power of motion so far supports the theory of natural selection. That the ear is not entirely gone, as he thinks it should be, may be due to its still being of service or to lack of sufficient time since it became useless.

RICHARD LEES.
Brampton, Ontario.

Leaf Impressions in the Eocene Tertiary of Alabama.

THOSE working geologists who are interested in what Professor Lester F. Ward[1] terms "The New Botany" may be somewhat surprised to learn that in the Eocene Tertiary strata of Alabama there is a promising and unexplored field for the paleobotanist. In fact there is reason to believe that a careful study of the plant-life existing in the Mississippi embayment during the well-marked subdivisions of the Tertiary will throw some light upon the knotty problems of the interior.

While the study by Lesquereaux of the Mississippi Lignitic was of interest and affords the present main means of correlating the trans-Mississippi Tertiary with that of the Gulf Coast, the value of this work for this purpose is somewhat diminished by the doubts as to the exact age of the several horizons in which the leaf impressions occur. On the other hand, the geological section so accurately established for the Tertiary in Alabama affords a key for the critical solution of age-problems in the Gulf Region. Between beds of marine shells, whose faunal features have been determined with relation to kindred deposits on the Atlantic border, are beds of sandy clays containing well-preserved leaf impressions. These are found in the Lower Tertiary at Bells Landing on the Alabama River, where numerous dicotyledonous leaves occur in the stratum between the Bells[2] Landing and Gregg Landing marine shell beds. In the middle Tertiary of the Claiborne group both at the typical locality[3] and on Barrows Mill Creek, a tributary of Conecuh River, Covington County, are extensive occurrences of fine fossil leaves.

The State Geological Survey of Alabama has some few specimens from each of these localities but no systematic collecting has been done and no determination of species has been made.

[1] Science, Vol. XXI., No. 521, p. 43.
[2] Bull. 41 U. S. Geol. Survey, 1887, p. 47.
[3] Am. Jour. Sci., 3d Ser., Vol. 31, 1886, pp. 2 2-229.

The fact that the exact age of each horizon referred to is clearly established in the geological column should make these beds of particular interest to the paleobotanist and should contribute materially to our facilities in correllating the much-discussed Interior Tertiaries. DANIEL W. LANGDON, JR., F.G.S.A.

Cincinnati, Ohio.

Bowser's Mathematical Text-Books.

I HAVE just read a note on "Bowser's Trigonometry" by Professor Hodgkins in *Science* of Jan. 20. Permit me to add a few words on Bowser's series, both in the way of praise and criticism, and, therefore, favoring both sides of the question. I used his analytical geometry and calculus for two years with good results. They are well adapted to the average student in arrangement, examples, and general plan, and they are more modern than most text-books of the same class. But the subject is sometimes unnecessarily complicated, as in solid analytics, where the beauty of the method of direction-cosines is seriously marred. Also, in respect to the details of accuracy of statement and logical demonstration, I am sorry to class the series among the free and easy kind of which we have so many, although among the best of that kind. The public is as much at fault for accepting and even demanding books in that style as are the authors for writing them.

Let me illustrate by his treatment and use of the method of infinitesimals. That method is at best a dangerous one, even in the hands of the masters, let alone the average student. This is sufficiently well illustrated by the errors into which Professor Bowser himself has fallen; and he should read the scoring that Clausius gave his mathematical critics on their use of infinitesimals. He will find that he is in good company. Most anything can be proved to the satisfaction of the average student, just as Professor Bowser establishes the differentials of the trigonometric functions. Thus, by trigonometry,

$$\sin(x+dx)+\cos(x+dx)=\sin x\sqrt{2}\cos\left(\frac{\pi}{4}+dx\right)$$
$$+\cos x\cos dx+\cos x\sin dx$$
$$=\sin x+\cos x+\cos x\,dx,$$

since $\sqrt{2}\cos\left(\frac{\pi}{4}+dx\right)=1$, $\cos dx=1$, $\sin dx=dx$.

Hence $d(\sin x+\cos x)=\cos x\,dx$, a false result.

Professor Bowser is more fortunate than the critics of Clausius, since he happens upon a final result that is correct; but, farther along, this good luck deserts him, in the case of a carefully-worked example (Calc., ex. 3, p. 325). Another case is ex. 8, p. 338. In view of these facts, I hope Professor Bowser will revise his demonstrations and eulogy on infinitesimals, to the decided improvement of his valuable book. A. S. HATHAWAY,

Professor of Mathematics, Rose Polytechnic Institute.

Terre Haute, Ind., Jan. 28.

Some Additional Remarks on Maya Hieroglyphic Writing.

IN a former communication, replying to some objection brought forward by Professor Thomas, I noticed that in the numerals, composed of straight lines and dots, which are seen accompanying the hieroglyphs of the Maya inscriptions, the one dot of the numbers 1, 6, 11, 16 always is supported and framed by two ornamental signs filling up the space, while no ornamental sign is seen between the two dots of the numbers 2, 7, 12, 17. I noticed this for a Copan Stela published by Alfred Maudsley (see the Figs. 1–16 in my former paper). I may add that the same applies to the inscriptions of the Palenque tablets, only that here the two dots of the number 2, like the one dot of the number 1, are framed by two ornamental signs, while the two dots of the numbers 7, 12, and 17, as a rule, are standing alone. I wish to state that although prevailing in most cases, this rule may allow some exceptions. Alfred Maudsley, page 39 of the text, gives drawings of the numerals, where an ornamental sign, similar to the two ornamental signs of the numbers 1 and 6, is seen between the two dots of the numbers 2 and 7. Maudsley does not mention where he has taken these figures. But, for instance, on the cross-tablet 1, of Palenque, in the hieroglyph V. 17, designating the twelfth day of the month Kayab, a somewhat peculiar ornamental sign, composed of two nooks, is seen between the two dots of the number.

In connection with these facts, I wish to mention that there really exists an instance of a cross between the two dots of a number in Dresden Codex 46, already mentioned by Professor Förstemann in *Zeitschrift für Ethnologie*, 23 (1891). p. 149, that, unfortunately, I had overlooked. DR. SELER.

Steglitz, Germany, Jan., 1893.

Languages of the Gran Chaco.

I WAS very much gratified to see that Dr. Brinton thinks well of my intention to publish all the material I can get hold of connected with the languages of the Gran Chaco. The following facts may be of interest to him and other Americanists on your side of our continent.

1. Dr. Brinton is quite right in giving the name of "Guaycurú" to the Abipone and other cognate dialects. The root word is *ary*, which simply means "a fierce savage." *Gu* and *curú* are simply particles.

2. The linguistic library of the La Plata Museum will comprise two series: First, the Guaycurú; second, the non-Guaycurú group.

The Guaycuru Group

a. MOCOBI. Father Tavolini's MS. faithfully reproduced; a grammar founded on same, with a preliminary discourse and other papers. An English version of the grammar.

b. TOBA. Father Barcena's MS. complete, with supplementary vocabularies by Carranza, Pelleschi, the editor, and others. A preliminary discourse on the language. An English translation of F. Barcenas Quires.

c. ABIPON. Father Dobrizhoffer's chapters on this dialect, supplemented from MSS. supposed to be Father Brigniel's, with a preliminary discourse, and most important vocabulary.

d. LENGUA. Cervino's MS. vocabulary. Evidently a cognate dialect, with Mansfield's Payaguá. Preliminary discourse on the same subject.

e. GUAYCURÚ. An essay on Castelnau and Gibû's vocabularies.

Non-Guaycuru Group.

a. A reproduction of Father Machoni's work on the Lule language, with an essay on the suffixing dialects of the Chaco.

b. An essay on the Vilela and Chulupí dialects, to accompany Pelleschi's vocabulary.

c. Mataco. Pelleschi's grammar and vocabularies, with notes and preliminary discourse by the editor.

d. Possible numbers in Mataguays, Nocten (Mataco dialects), and Chiriguano (a Guarani dialect).

Dr. Moreno, director of the La Plata Museum, is doing his best to push this work forward. SAMUEL A. LUFONE QUEVEDO.

Pilciao, Catamarca, Argentine Republic, Dec. 18.

Controversies in Science.

IT might be well for scientific controversialists to bear in mind that undue heat is an indication — as in mechanics — of want of that balance that should constitute a judicial mind. The world generally views with amusement the frothy utterances of the man on the wrong side who finds himself hard pressed by reiterated facts, and judges him to be in the wrong, frequently, by his language, when he may be correct entirely. One without any knowledge of the facts of the present controversy between a few persons connected with the U. S. Geol. Survey — a survey at present under a cloud from the disbelief of Congress as to its needs and usefulness — and the upholders of "palæolithic man," would naturally incline to the side taken by Professor Wright, merely from the perfect courtesy and evenness of temper which he has preserved under exceptional circumstances. It is seldom in the course of controversy that a clergyman of good character has been so bespattered with epithets, inuendoes, and charges that would render him — if true — worthy of abrupt expulsion from any position of trust, or from any decent religious body.

It is probably because Professor Wright is so secure in his position that he can afford to pass by in silence the statements that any sane man can see are unwarranted, and the attention of the world at large may have been directed to him by these very attacks, as well as arranged on his side by their baselessness. The writer does not wholly agree with the professor; but he can thank him for a good example of a disputant. The time has passed when the progress of knowledge can be dammed by the straws of a few determined opponents, and the examples of the primordial and cretaceous controversies cannot be safely repeated. It has been the shame of America that it has been so taken up in petty fights over side issues that it has left to others abroad the building of the science of geology.

In the future the combatants in the arena had better take as their type, the old-fashioned town pump. It always works best in the cold and deliberation of winter, and the quality of its product is beyond question. When the heats of spring come it begins to diminish its flow, and during the controversial dog-days it dries up.

Edward P. Williams, Jr.

Bethlehem, Pa., Feb. 6

BOOK-REVIEWS.

The Hemiptera Heteroptera of the British Islands. A descriptive account of the families, genera, and species indigenous to Great Britain and Ireland, with notes as to localities, habitats, etc. By Edward Saunders, F.L.S. London, L. Reeve & Co., 1892. With 32 plates. Price, £2, 8s.

The late well-known naturalist, the Rev. J. G. Wood, used to deliver a popular and entertaining lecture on "unappreciated insects." Among these he included the one which is familiarly termed the black beetle. To this he endeavored to reconcile feminine taste and intelligence by representing that its approach infallibly scares from our chambers the more dreaded and more vicious bed-bug. But this latter is itself one of the unappreciated, for which even a very skilful advocate will not easily conciliate our esteem. The best perhaps that can be said for it is that the barest suspicion of its presence is an incentive to cleanliness. The modern feeling about this special nocturnal terror is happily, however unintentionally, expressed in that old version of the Psalms, which brought home to the reader a deep sense of comfort and security by the wording, "so that thou shalt not nede to be afrayd for any bugges by night." It is singular that collectors of insects should have adopted for themselves as a kind of pet name the title of bug-hunters. Perhaps they have wished to wrest a weapon out of the hands of the scornful, with the feeling that it is more agreeable to call oneself names than to be called names by other people.

The students of bugs in particular, as distinguished from those who study insects in general, are comparatively few. It is probable that, for the sins of a single and not very characteristic species, a prejudice has been evoked in the public mind against the whole order to which the objectionable species happens to belong. There has been plenty of time for prejudice to gather strength, since the genus *Cimex* is said to have made its first ascertained appearance in the far-distant Liassic period. There is something wonderfully romantic in the thought of this blood-thirsty genus biding its time, waiting, craftily waiting through so many ages till man should appear upon the mundane scene with lodgings to let! But as it must be confessed that its habits, however venerable for their antiquity, have placed all its kindred more or less under a cloud, there is the more reason to acknowledge the spirited enterprise of Messrs. Reeve in publishing an expensive work on this rather neglected department of zoölogy. There is, however, good reason to think that the volume, being such as it is, will largely help to cure the neglect of the subject. The beginner learns at the outset that most of the species are vegetable-feeders, and that, from the few that are less temperate, the collector runs practically little or no risk of harm. From the beautifully colored plates it is obvious that many of the species must be in nature highly attractive. The clear descriptions of all the species at present known in Great Britain and Ireland

CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

Feb. 7.—O. T. Mason, Co-operation in Anthropological Work; Clifford Howard, The Philosophy of Sin; W. H. Holmes, Early Man on the Upper Mississippi.

Biological Society, Washington.

Feb. 11.—M. B. Waite, The Destruction of Lichens on Pear Trees; C. H. Townsend, The Propagation of the Atlantic Coast Oyster on the Pacific Coast; Charles Hallock, The Geographical Distribution of the Musk-Ox; C. Hart Merriam, The Four-Toed Kangaroo Rats (with exhibition of specimens); F. A. Lucas, The Food of Humming-Birds.

Society of Natural History, Boston.

Feb. 15.—Henry W. Haynes, More Evidence of Cannibalism among the Indians of New England; R. T. Jackson, Notes on the Development of Palms; S. J. Mixter, A Massachusetts Beaver Dam.

will, in the first instance, appeal especially to British students, but from one point of view they may still more court the attention of students elsewhere, for, when specimens are unattainable, good descriptions and figures are an exceedingly welcome substitute. Every one must value the facilities for work provided by the elaborate synoptic tables.

Those who can remember the devotion to natural history of the late Mr. Wilson Saunders and the vast and admirable collections of insects which he accumulated from all parts of the world, may be disposed to believe that his son, the author of the present work, was born as well as bred an entomologist. The name of Edward Saunders, to those acquainted with his lifelong studies and with his previous writings, will be an ample guarantee that in this book also they will find the most conscientious accuracy and all the thoroughness of treatment that the subject admits. It is commonly reported in England that the revenue officers of the United States levy duty upon meteorites which descend from the sky, but probably the hemiptera pass the frontier without the least regard to tariffs, or quarantine regulations, or laws against the importation of destitute aliens. How little, then, can the free-trade precincts of Great Britain and Ireland hope to defy the invasion of any new bug that may choose to enter! But, at any rate, the collector who finds within those precincts one of the Heteroptera that has not been described in the volume now under review, may well suspect that it has been recently introduced into them from without.

In a work so sumptuously printed one may be permitted to wonder why there is no index to the plates and why no references are given in the text to the excellent figures which those plates contain. As a matter both of good taste and convenience it would surely also have been better to give in full the names of authorities, instead of such abbreviations as Muls. and Put. for Mulsant and Puton. The reader may find a chance of guessing that Boh. and Fall. stand for Bohemann and Fallen, but Lap. and Spin. and Duf. find no explanation within the four corners of the book itself. The title, "Hemiptera Heteroptera," is quite justified by the usage of other authors, and Hemiptera seems really a better title than the alternative Rhynchota, but in the division of the order into Heteroptera and Homoptera it is very unsatisfactory that the names applied to the suborders should have the same termination as that appropriated to so many orders of the Insecta. A protest may be made, too, against the use, now becoming common, of the word "asymmetrical." Those who are discontented with "unsymmetrical" ought to write "haymmetric," and be pedantic at both ends of the word. From misprints and similar blemishes the volume is very agreeably free, although there is some obscurity in the account of *Corixa*, which is said to contain twenty British species divided into four subgenera, whereas the synoptic table shows six subgenera and twenty-five species, to which a twenty sixth is doubtfully added in the descriptions.

The zeal of collectors will be stimulated to find again such prizes as *Aradus Lawsoni* and *Pygolampis pidentata*, or the greenish black *Prostemma guttula*, with scarlet legs and elytra, and antennæ pitchy brown. But the study of the group has more to commend it than the tantalizing rarity of some of the species. It is no little advantage that a great many of them are on the contrary common and easy to obtain. They do not, it is true, flaunt themselves in mid-air like butterflies or birds, but rather keep themselves quiet on trees and various lowlier plants, in mosses, in ponds, and other retreats, from all of which they can without much difficulty be induced to come forth. The search for Hemiptera is pleasantly united to the observation of plant life, and when a collection has been made, the curious shapes and bright colors of the specimens are likely to be associated with treasured memories of holiday excursions, fair scenes, and delightful rambles, that have been enlivened by this quest. Few of those who make themselves acquainted with Mr. Saunders' volume will continue to despise the Hemiptera, and few of those who take any deep interest in the Hemiptera will care to be without Mr. Saunders' volume.

THOMAS R. R. STEBBING.

Tunbridge Wells, England.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For sale or exchange.—I have a few copies of my translation of "Strasburger's Manual of Vegetable Histology, 1887," now out of print, which I will send post-paid for $3 or for one dozen good slides illustrating plant or animal structure. Address A. B. Hervey, St. Lawrence University, Canton, N. Y.

The undersigned has the following specimens to exchange for crystals of any eastern or foreign localities or Indian relics: tin ore, metacinnabarite, stibnite, garnierite, calenanite, hanksite, ulexite, rubellite, lepidolite, blue and green onyx, Cal. pinite, arsgonite on chalcedony, cinnabar, double refracting spar, clear and clouded, and others. J. R. Bush, care of General Delivery, Los Angeles, Cal.

For sale or exchange.—A private cabinet of about 200 species of fossils, well distributed geologically and geographically. Silurian, about 40; Devonian, about 50; Carboniferous, about 80; others, about 30. Frank S. Aby, State University, Iowa City, Ia.

For exchange.—Minerals, fossils, F. W. shells, land shells, native woods, Indian relics, two vols. of Smithsonian reports, odd numbers of scientific magazines, copper cents, etc., for good minerals not in my collection, good arrow- and spear-heads and natural history specimens of all kinds. Correspondence solicited with list of duplicates. G. E. Wells, Manhattan, Kan.

For sale or suitable exchange.—A spectrometer made by Fauth & Co., Washington, D. C., according to the plan of Prof. C. A. Young. This instrument is suitable for the most advanced investigations and determinations. Cost originally $700 and has been used but little. Will be disposed of at a considerable reduction. Address Department of Physics, Ohio University, Athens, O.

I will send British land and fresh-water shells in return for those of America, any part, sent to me. I have at present about fifty or sixty species, with many varieties. W. A. Gain, Tuxford, Newark, England.

The Biological Department of Hamline University desires to offer microscopic slides of animal tissues, or whole animals, in exchange for first-class fossils. Address correspondence to Henry L. Osborne, Hamline University, Hamline, Minn.

Wants.

CAN any one inform me as to the age to which cats have lived? I have one twenty years old. Edward D. Webb, 132 W. Eighty-first St., New York.

WANTED — Second-hand. Foster's Physiology, Balfour's Comparative Embryology, Claus & Sedgwick's Zoology, Flower's Osteology of Mammalia, Vine's Physiology of Plants. Please state editions and prices asked and address Richard Lees Brampton, Ontario, Canada.

WANTED.—American Journal of Conchology, seven volumes. Parties having these for sale will please address the undersigned, stating condition and price. R. Ellsworth Call, Louisville, Ky.

A GRADUATE ENGINEER will give instruction evenings in geometry, trigonometry and surveying, mechanics, physics, mechanical drawing and general engineering construction. Five years' experience in field and editorial work on engineering journal. References furnished. C. S. H., 102 Tribune Building, New York.

WANTED.—By well-qualified and experienced science master and associate of the Royal School of Mines, London, aged 26 (at present in England), a mastership in technical college or university for any of the following subjects: Engineering sciences, geology and mineralogy, physics, chemistry and metallurgy, etc., etc. Can provide excellent references and credentials. Apply, J. G., 17 Sussex St., Rochdale, England.

A GRADUATE of the University of Pennsylvania and a practical mineralogist of twenty years' experience desires to give his services and a cabinet of 25,000 specimens, all named, with about the same number of duplicates, in minerals, crystals, rocks, gems, fossils, shells, archæological and ethnological specimens and woods to any institution desiring a fine outfit for study. The owner will increase the cabinet to 50,000 specimens in two years and will act as curator. Correspondence solicited from any scientific institution. J. W. Horiter, M.D., Ph.D., San Francisco, Cal., General P. O. Delivery.